# PEAT MOSS:
## A GIFT THAT KEEPS ON TAKING

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## EXECUTIVE SUMMARY

Peat moss is a naturally occurring, non-sustainable resource used in horticulture, fuel production and water filtration systems. Its availability and applications have environmental, geopolitical and national security implications that demand awareness and action. As the global population continues to rise, demand for peat moss increases significantly for its essential role in the food supply chain; yet, the market supply for natural peat has decreased significantly in recent years, creating competition for food resources. The United States currently imports 72 percent of its peat moss, a majority of which comes from Canada. We estimate that over 95 percent of all peat moss used for horticulture in the United States is imported.

Increased food production necessary to sustain global populations will require additional sources of peat; however, countries with large reserves of peat moss have regulated its harvest due to its negative environmental impact. Steps must be taken in order to avoid a global food shortage. A true peat moss substitute must be used to secure food supply and prevent further global warming.

**KEY FINDINGS:**

- Peat moss is an important soil additive and growth medium for seedlings.
- Demand for peat moss is forecasted to increase by up to 40 percent from 2020 to 2030 while supply is estimated to decline by 20 percent. This forecasts a massive supply gap.
- The peat moss supply gap will increase global prices for peat moss, triggering higher food prices for consumers. Increased food price volatility will reduce food availability domestically and globally.
- The United States is the largest food exporter, being a critical food resource for countries with insufficient food production. Import reliance on peat moss coupled with the decline in peat moss supply could put the U.S. in potential trade conflicts.
- Domestically produced peat moss replacements like TEFA® have significant economic and ecological benefits to the U.S.
    - Elimination of import reliance
    - Reduced transportation costs which translate to lower costs as a growth medium
    - Potential income and employment opportunities for farmers
    - Reduced $CO_2$ emissions from lack of peat moss harvest and decomposition
    - Reduced food price volatility
    - Domestic food security and availability

## INTRODUCTION

The United Nations anticipates the global population will reach 9.7 billion by 2050, requiring an additional 40 percent (+) of food needed to sustain demand. Meanwhile, rising temperatures create a steady decline in crop yields, and by 2050, crop production is expected to decrease by an additional 23 percent. This is an alarming trend that requires immediate action and proactive, innovative solutions to guarantee the security of the world's food supply.

The bedrock of plant-based resources requires high-quality soil and growth mediums for seedlings. For decades, peat moss has been the answer. With its acidic pH and water retention qualities, peat moss is the perfect foundation for all plants – but not without a price. Harvesting peat moss is incredibly detrimental to climate change. In fact, its harvest has been restricted or eliminated in many countries around the world.

An eventual peat moss shortage is imminent. A global race to the bottom will trigger higher prices and geopolitical tensions. The United States currently imports a net 70 percent of its peat moss. Based upon data by the United States Geological Survey (USGS), we estimate that 95 percent of all imports are used for horticulture, making the U.S. horticultural industry almost completely import dependent.

## WHAT IS PEAT MOSS?

Peat moss is the product of decayed moss and other plant matter founding peatlands around the world. Peatlands have been growing for the last 8,000 to 12,000 years; they absorb carbon and store it below the water's surface during decomposition. When harvested, the wetlands must be drained and dried out before the peat can be removed. It is during this excavation process that stored carbon is released into the atmosphere as a greenhouse gas.

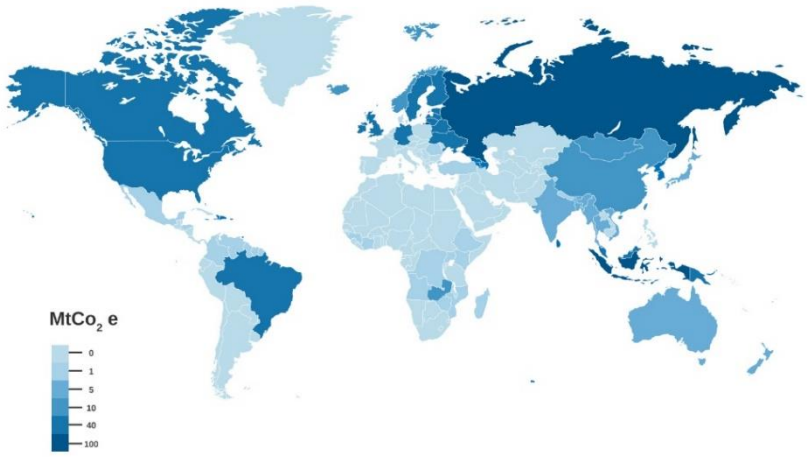
Peat moss is nature's gift that absorbs carbon and provides a growing foundation for plants, but its use is destructive to the environment.

*Sphagnum* moss is the most desirable form of peat moss for horticultural purposes and is found primarily in northern peatlands. Northern peatlands account for approximately three percent global land mass. It is estimated that peatlands once stored approximately 500 gigatons of carbon and approximately 10 percent of the world's freshwater resources, making peatlands an important component in the global carbon cycle.

## ENVIRONMENTAL CONCERNS

Environmental interests surrounding peat moss are multifaceted and illicit a global conversation surrounding air pollution and climate change. When natural peat is harvested, wetlands are first drained and dried out to remove the peat. It is during this process that carbon stored below the water is released into the atmosphere as $CO_2$. Peatlands are found around the world and studies highlight a direct correlation between peat moss harvests and increased $CO_2$ emissions.

***Exhibit 1: CO2 Emission from peatlands by country***

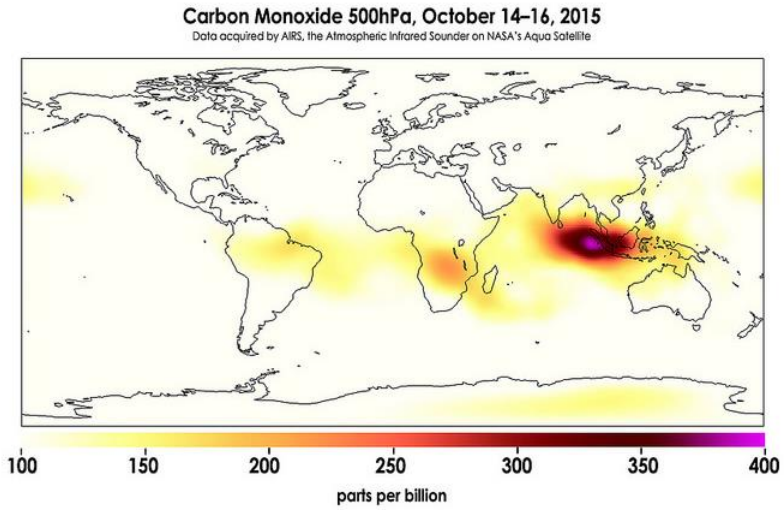



Source: Wetlands International, Briefing paper: accelerateing action to Save Peat for Less Heat!

Dried peatlands are highly flammable and can cause fires that burn for months and cause destruction and air pollution.

Moreover, dried peatlands are highly flammable and pose a major threat to the safety of the regions in which they are found. Often a small spark can cause an uncontrollable fire capable complete devastation. In 2015, Indonesia experienced one of the largest peat fires in history; it burned for months and caused record high levels of carbon monoxide emissions into the atmosphere.

***Exhibit 2: Carbon Monoxide Over Indonesia Fires***




Source: NASA AIRS (2015) Carbon Monoxide in Mid-Troposphere over Indonesia Fires, October 14-16,2015. Retrieved from https://airs.jpl.nasa.gov/resources/images/159

To combat $CO_2$ emissions from peat, countries around the world have instituted regulatory change and heavily restricted the harvest and use of natural peat moss. In the United States, harvesting is restricted through stringent legal hurdles, and peat moss is not used as a fuel source. China, one of the largest consumers of peat moss worldwide, tightened control over its use and began a USD $1.5b protection initiative which returns field lands to wetlands to avoid further damage through peat moss harvesting. Important peat producing countries in Europe such as Estonia, Germany, Ireland, and Great Britain have also mandated a reduction of peat moss harvesting and put strict limitations on its use. Producers are now required to return harvested fields to wetlands which is a costly and time-consuming effort, leading to increased peat moss prices.

Canada must reduce $CO_2$ emissions by 200 million tons over the next 10 years.

Canada, one of the world's largest producers of peat moss and the primary supplier to the U.S. horticulture industry, has also established peat moss management regulations in recent years. According to the most recent Canadian climate report, temperatures in Canada are increasing twice as fast as in other countries across the globe. Canada vowed to cut $CO_2$ emissions by 200 million tons over the next 10 years, but the United Nations suggest this is not enough to avoid potential disasters like deadly heat waves and extreme storms[1]. Pressure

[1] Rabson, M. (2019). Canada warming twice as fast as rest of the world, scientific report shows. *The Canadian Press in BNN Bloomberg.* Retrieved from

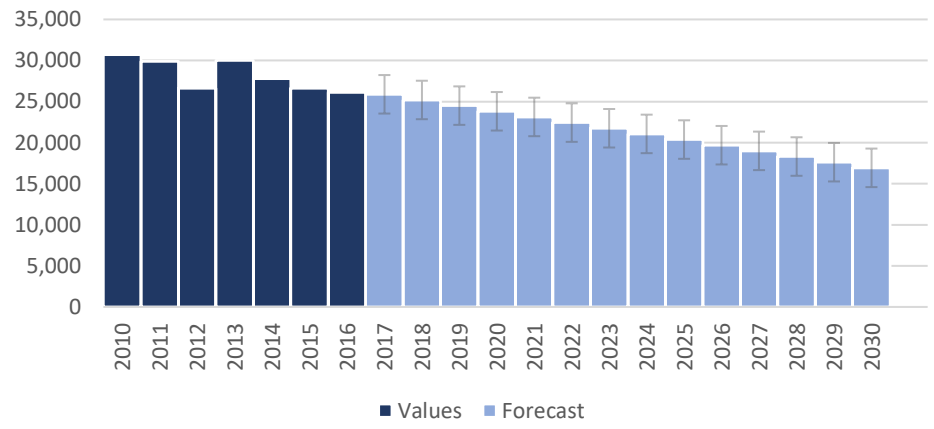
from the U.N. would deliver a significant blow to the Canadian peat moss industry as studies indicate the country's harvesting activities contribute to an additional 15 percent of GHG emissions[2], while transportation emits an additional 10 percent, and its extraction and processing account for approximately 4 percent additional GHG in Canada.

## PEAT MOSS PRODUCTION

Global peat moss production is forecasted to decline by CAGR 3.37 % until 2030

Global production of peat moss was an estimated 28 million metric tons in 2018. This number reflects a decline of 4 million metric tons (13 percent) over 5 years. Accounting for international initiatives to reduce or stop peat moss production, we estimate that global production could decline by CAGR 3.37 percent until 2030. This represents a total production volume of 17 million metric tons. We estimate that the production for horticultural use will decline by CAGR 0.80 until 2030, producing a concerningly low 8 million metric tons in 2030.

***Exhibit 3: Global Peat Moss Production Forecast** (in thousand metric tons)*

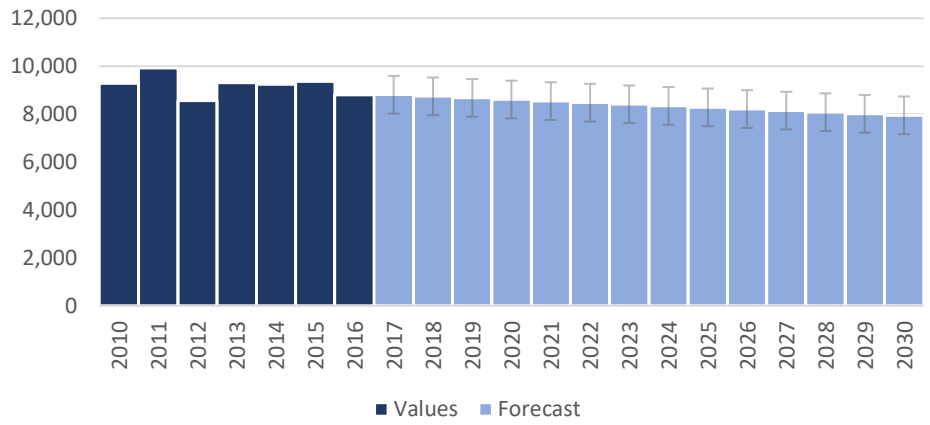



Source: USGS (2018) 2016 Minerals Yearbook Peat, Sustainable Projects Group Inc.

https://www.bnnbloomberg.ca/canada-warming-twice-as-fast-as-rest-of-the-world-scientific-report-shows-1.1238203

[2] Cleary, J., Roulet, N. T., & Moore, T. R. (2005). Greenhouse gas emissions from Canadian peat extraction, 1990-2000: A life-cycle analysis. Ambio, 34(6), 456-61.

***Exhibit 4: Global Peat Moss Production for Horticulture** (in thousand metric tons)*




Source: USGS (2019 Minerals Yearbook Peat Summary; Forecast Sustainable Projects Group Inc.

There are 31 reported peat moss producers in the United States that source some 500,000 metric tons of peat moss. The breakdown is 15 percent *Sphagnum* (used in horticulture), 82 percent *Reed-sedge*, and approximately 3 percent *Hypnum* and *humus* moss combined. Florida is home to the largest naturally available sources of peat moss in the United States but accounts for less than a fraction of a percent of total demand.

## HOW IS PEAT MOSS USED?

The primary applications of peat moss are fuel production, horticulture and agriculture. Globally, approximately 50 percent of harvested peat moss is used for fuel and 33 percent for horticulture. The remaining 17 percent is used for other applications across industries such as healthcare and construction. Although its use for fuel is in decline, there is a significant difference in quality amongst the various types of mosses and not all fuel-suitable peat moss can be used for horticultural purposes. Therefore, experts anticipate a shortage of horticultural-ready peat moss in the near term.

Peat moss is a horticultural basis for growing seedlings.

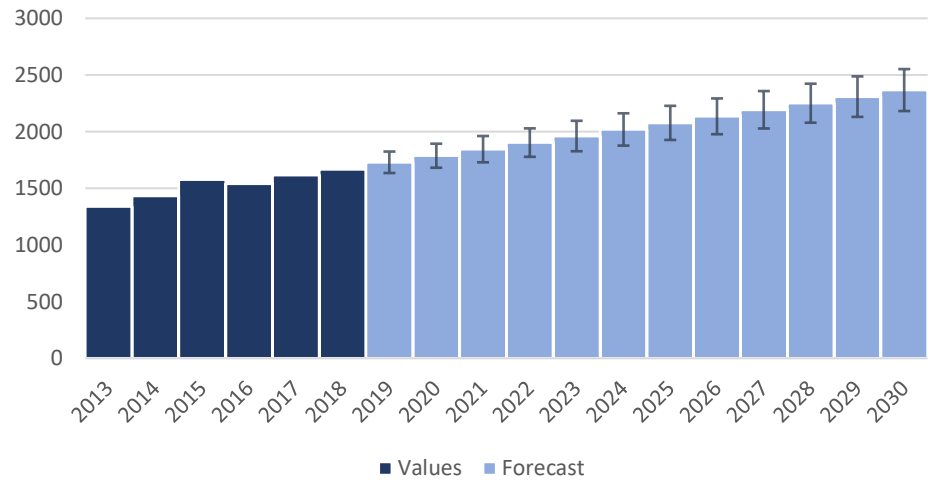
Found in northern peatlands, *Sphagnum* moss is best used in horticulture. The United States imports *Sphagnum* moss almost exclusively from Canada as horticulture is the primary use of peat moss in America. Peat moss is sold either directly from soil producers and soil mixers for uses in commercial food production (such as seedling starters or for soil additives), or in smaller bags at

garden centers and nurseries for hobby gardening. It is also used in potting mixes, hydroponic growth medium, and animal bedding/litter.

Between 2013-2018, peat moss consumption in the United States alone increased by 24 percent to 1.7 million metric tons. Based on historical increases in demand and the growing concerns for food scarcity, we estimate that the demand for peat moss could increase to over 2.3 million metric tons per year by 2030, representing a 42 percent increase. Over the same time frame, we estimate world production of peat moss to decline by 37 percent.

The annual US demand for peat moss is forecasted to increase by 42% by 2030, while world production will decline by 37%

***Exhibit 5: Peat Consumption in the USA** (in thousand metric tons)*




Source: USGS (2019 Minerals Yearbook Peat Summary; Forecast Sustainable Projects Group Inc.

## *Impact on Native Vegetation*

$CO_2$ emissions from peat moss harvesting are not the only environmental threat the resource poses. Growers and researchers have discovered that the use of imported peat moss is harmful to native vegetation. It was long believed that pasteurized northern peat moss does not include any fungi (*ectomycorrhizal propagules ECM*). Yet results from recent field studies identified over 770 different ECMs which were from foreign areas. Fungi embedded in imported peat moss can spread and infect local plants and vegetation[3]. The lack of natural boundaries enables fungi to blossom into an invasive species, attacking the

Imported peat moss is not sterile and can cause harm to native vegetation

[3] Angeles-Agaiz, R. E., Flores-Garcia, A., Ulloa, M. & Garibay-Orijel, R. (2016). Commercial sphagnum peat moss is a vector for exotic ectomycorrhizal mushrooms. *Biol Invasions18*, 89-101. Doi:10.1007/s1053-015-0992-2

natural vegetation and negatively impacting plant and seedling growth. Some fungi were identified to be heat resistant, capable of surviving even the most devastating forest fires.

To combat new invasive fungi species, growers must reduce or eliminate the use of foreign peat moss. Potting soil and soil mixes sold in garden centers, which currently rely heavily on Canadian peat moss imports, must avoid foreign peat moss to prevent the spread of fungi among home gardens and natural vegetation. Given the low amount of peat moss produced locally in the U.S., focus must be placed on finding viable peat moss alternatives.

## GLOBAL FOOD DEMAND AND PEAT MOSS

There is strong correlation between global demand for peat moss and changes in food demand. The United Nations reported in 2017 that the world population would increase annually by approximately 83 million people with an estimated total world population of 9.7 billion people by 2050. Population growth increases demand for food, and it is expected that food demand will increase at a faster rate than total population growth.

Population growth and changes in diet increase food and peat moss demand globally

Developing countries are expected to experience the largest rises in population, especially South Asia and sub-Saharan Africa. Food demand is fueled by a repurposing of agricultural land, increased urbanization, higher incomes, and technological advances. Also, the per capita calorie consumption of individuals has increased by 23 percent from 1966 to 2008. This growth is anticipated to moderately grow through 2050.

Increased food demand is also reflected in the demand for peat moss. The International Peatland Society (IPS) reported China has an estimated annual demand of peat moss for seedling growth of 49.51 million cubic meters (9 million tons) and for greenhouse soils of 100 million cubic meters (21 million tons). Including all other applications, IPS reported an estimated total annual peat moss demand in China of 250 million cubic meters (50 million tons)[4]. Compared to a reported consumption of only 190,000 tons in 1990, this represents a significant increase in demand that will widen the global supply gap. The Finland-based substrate producer, Biolan, estimates the total demand for rooting material to quadruple by 2050.

Higher regional incomes also change the type of food demanded. In higher income economies, people seek higher protein diets, increasing the demand for

[4] Conversion cubic meter to tons was calculated with density of 201kg per cubic meter. Conversation rate was published by USGS 2016 https://www.usgs.gov/centers/nmic/peat-statistics-and-information

livestock. This shift from a crop-based diet to a more livestock-based diet increases the need for feed grasses and grains. Farmers will be expected to increase crop yields through innovation and technology, despite losing land to other purposes, and to further counteract the increasing negative impact of lower crop yields stemming from climate change.

If food demand in current low-income countries continues to increase, it is possible that in 2050, countries like China and India will have a meat and dairy demand equal to the demand of western countries in 1966. That shift alone would require feed grain production to increase by approximately 50 percent by 2050. More peat moss will also be needed, widening the gap between peat moss supply and demand, and adding additional constraints and challenges for farmers.

## *Impact on the U.S. Market*

Historically, the United States has maintained its position as the largest food producer, exporter and donor on the planet. This role can be attributed to available land, as well as investments in agriculture, innovation and capital. In response to climate change and unusual weather patterns, U.S. farmers increasingly face declining crop yields. Combined with amplified soil erosion, American farmers are in critical need of sustainable soil solutions. Peat moss produces high-yield crops and U.S. farmers depend on peat moss imports to meet growing demands.

The significant supply gap developing in peat moss must be filled soon to avoid interruption in the global food supply chain

Conventional economic wisdom indicates that the widening gap between the natural supply of peat moss and demand for higher levels of food production will result in increased prices. As nations look to curb peat moss production, the declining pool of suppliers will be unable to meet demand necessary to sustain adequate levels of food production. The result is high competition among buyers and increased prices for peat moss. U.S. farmers' dependence on peat moss imports will force competition amongst buyers from European and Asian countries within a shrinking supply market. The competition threatens higher product prices for consumers and/or a reduction in the food supply.

While the U.S. maintains a surplus in food production, food exports account for approximately USD $133 billion. As the largest food exporter in the world, the United States plays a critical role in the global food supply chain. A shortage of peat moss or higher prices would inevitably interrupt the global supply chain and threaten famine in food-importing regions of the world, encouraging poverty and potential political unrest.

American consumers are already impacted by inflation in food prices. A weak U.S. Dollar caused food prices to rise by 8.2 percent in 2017. Increasing exports

reduced supply in the domestic markets, resulting in higher prices. In 2018, hurricanes and other natural disasters in the United States resulted in price increases in food products. Increasing oil prices also increase food prices due to the rising cost of food transportation. The cost of oil by-products which are important components of fertilizer, further impact price as do prices for growing mediums like peat moss and its transportation.

## FINDING A SOLUTION TO SECURE FOOD RESOURCES

The United States is almost completely reliant on peat moss imports from Canada. The Canadian peat moss industry must meet requirements to reduce $CO_2$ emissions, therefore restricting harvesting. Rainfalls also affect the harvest of Canadian peat moss and such weather uncertainty further effects the cost of peat moss.

To combat rising food prices, the United States must reduce its reliance on foreign peat imports. Domestically sourced peat moss substitutes create multiple advantages for the United States. Notably, the U.S. would not be in competition with other peat moss importers and can avoid potential trade tensions. Reduced transportation requirements would further reduce financial and environmental costs.

To protect and secure food resources, the market needs a true peat moss replacement

Environmental issues concerning peat moss harvesting have long been known and studied. With growing concerns for climate change and the known devastating impact of $CO_2$ emissions, European countries such as Germany and Ireland increased regulations and imposed greater restrictions on peat moss harvesting, committed to reducing its production. The reduction, or even the end of peat moss harvesting, is an important step forward in in the effort to reduce carbon emissions. Unfortunately, it creates a new, much larger issue: domestic and global food security.

Global restrictions on the harvesting of peat moss were set without a viable true substitute in place. Growers, innovators, and environmentalists have taken the initiative to identify and develop potential substitutes; and while there are some potentials on the market today, few are capable of completely retiring natural peat.

One popular substitute is coconut fiber – *coir*. The product is valued for its water retention capacity and root support. But due to its high salt content, water usage during production is very high. The product is suitable for some applications but is not as versatile as peat moss and therefore not considered a true peat moss substitute. Sri Lanka and India are the two main producers of *coir*. Were the United States to transport a *coir* substitute, farmers and consumers would be

further hindered by additional transportation costs from ships and trucks, not to mention it would maintain U.S. reliance on imports.

Peat moss growers have recommended live *Sphagnum* moss; it possesses qualities equal to that of peat moss and its harvest does not require wetland drainage. But while live *Sphagnum* moss is a suitable substitute, it requires approximately 15 to 20 years to regenerate before it is ready for harvest. Not to mention, the amount available is nowhere near capable of sustaining global demand, and the U.S. would remain import reliant.

Other substitutes on the market are wood waste products like sawdust and wood fiber, compost products, and even municipal sewage waste. However, none of these products have the water retention qualities of peat moss.

During the thirty-year search for a peat moss replacement, some innovative products have reached the market. For example, in 1994, the Pennsylvania based company, Pittmoss, introduced a peat moss replacement made from paper waste. The company continues to offer the product made from construction, food industry, and other recycled products to the gardening industry.

The Taiwanese company, Acelon Chemical and Fiber Corporation, filed a patent for artificial peat moss manufactured from natural fibers using technology from synthetic or semi-synthetic fiber manufacturing. It does not appear that this technology is currently being used for production.

Cormo USA Inc. is the only provider of a true peat moss substitute made from natural sustainable resources

The innovative peat moss replacement TEFA® by Cormo USA Inc[5]. is one viable solution for domestic food independence and environmental protection. The use of TEFA® will reduce overall $CO_2$ emissions due to lowered transportation requirements, lack of peat moss harvesting, and continued peat moss decay as a soil medium. Domestic production of peat moss using corn stover provides economic development through employment and income opportunities in agriculture. The United States is one of the world's largest corn producing countries and has enough raw material available to meet the U.S. production demands for peat moss products. The benefits of TEFA® contribute to reduced food price volatility, the elimination of import reliance for the most foundational human needs, and a reduction in environmental pollution.

[5] Cormo and Sustainable Projects Group Inc. entered a collaboration introducing the concept to the US market as Cormo USA Inc., a Florida corporation.

## ACTION NOW

To avoid a potentially destabilizing disruption to domestic and international food supplies, it is essential that industry implement the use of peat moss replacements. The climate crisis is a reality that can lead to a political crisis. Awareness and demand for change has increased in the United States and Europe, leading to net-zero $CO_2$ emission goals to be implemented by 2050. These goals require planning, commitment, and support from all stakeholders.

Farmers in the United States, known to be persistent and innovative, are off to a great start. In the second half of the 20th century, U.S. farmers increased crop yield through advanced practices and technologies. Their increased yield supported growing global demand for food. Providing farmers with the tools and methods capable of curbing $CO_2$ emissions, protecting soil and reducing water usage, while also maintaining or even increasing yields, will be a rudimental yet necessary step in fighting climate change now.

U.S. farmers are the backbone of the global food supply and currently lack the tools and support needed to combat environmental changes and continue to provide the food to the world.

Using corn stover to produce a sustainable peat moss replacement has not only an environmental benefit; it presents a lucrative economic opportunity for U.S. farmers. Establishing new income sources enables American farmers to better support their families and farms, and to continue to produce much-needed food resources for the world.

Concerns about global warming, climate change, air pollution, and water pollution from carbon emissions have long been discussed without a clear call to action. Global warnings indicate temperatures could rise to devastating heights by 2050, leading to destructive weather patterns. Action must be taken now to reduce $CO_2$ levels in the atmosphere and provide more sustainable alternatives to secure our food supply.

Making a viable peat moss alternative such as TEFA® made by Cormo USA Inc. available to the American and world markets provides a small but significant solution in the global fight against climate change and high $CO_2$ emissions while also encouraging economic advantages for American farmers from an otherwise wasted resource.

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**Specific notices of possible conflicts of interest with respect to projects or properties forming the subject of this report according to US or English law: None**

[ii]

[i] During research it was discovered that global data on peat moss demand and supply and pricing is inconsistent and incomplete. Assumptions made in this report are based on publicly available resources and held conservative.
[ii] List of sources used available upon request.